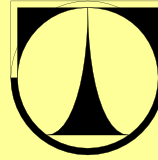




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Experiment Instructions
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CoAN
Compressed Air Net
(SIMATIC S7)

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1 Function Description

The device shows the function of a net with compressed air. The pressure is simulated internally and the value displayed on an analog indicator panel (figure 1 and 2). According to the amplitude of the pressure the sensors S6 (pressure over maximum) or S6 (pressure under minimum) deliver a true or false value.

The pressure can be controlled with the pumps M1 and M2 (inlet) and the valves Y1 (inlet) and Y2 (outlet)

The actual value of the pressure in the network can be recorded by the SPS with the analog input (PEW800) in the range between 0-10V (0-100 %). The power of the pumps M1 and M2 can be controlled over the SPS with analog outputs in the range of 0-10V (0-100 %) over PAW800 and PAW802 and switched on/off over the digital SPS-outputs. The outlet valve Y2 can be switched on/off by an SPS-output and controlled manually over the dial "Outlet".

The SPS is connected over a cable with the digital and analog inputs and outputs of the system.

The system is controlled by the user over buttons which are connected to the SPS. The function and mode is displayed with LEDs which are controlled from the SPS.

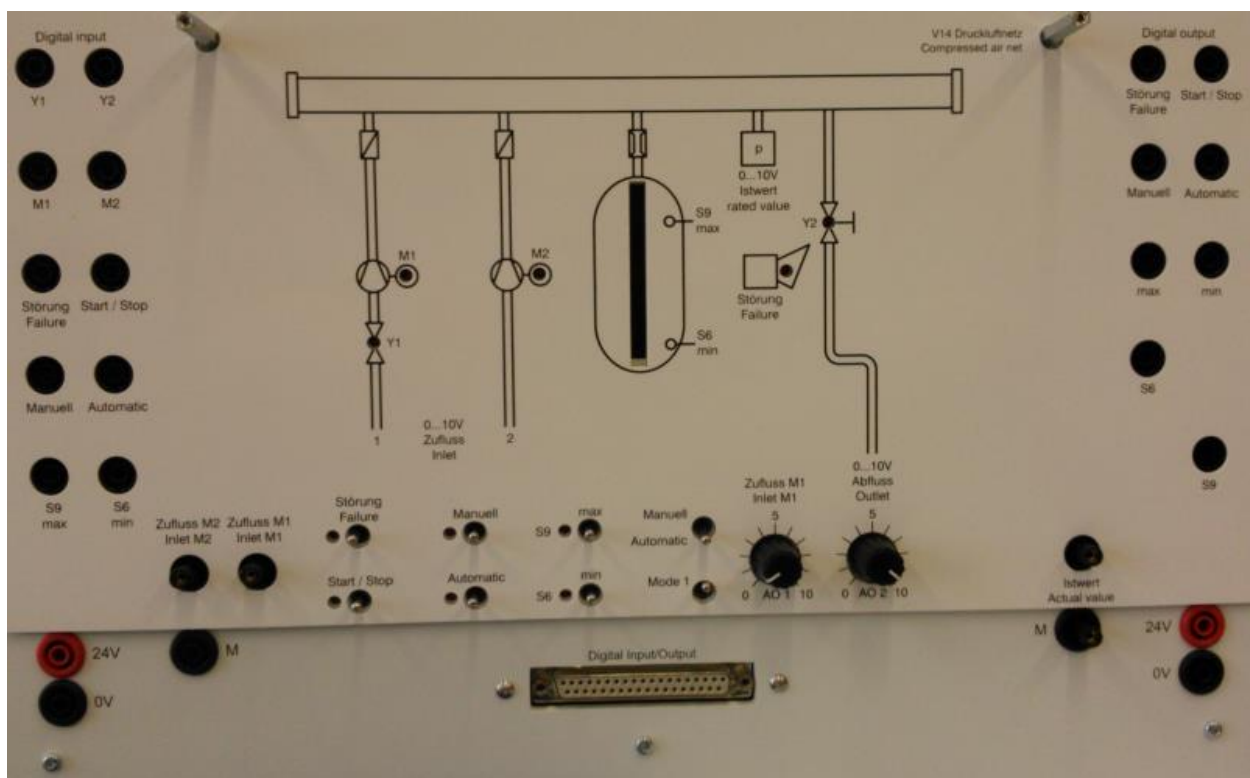


Figure 1: Panels and Connectors

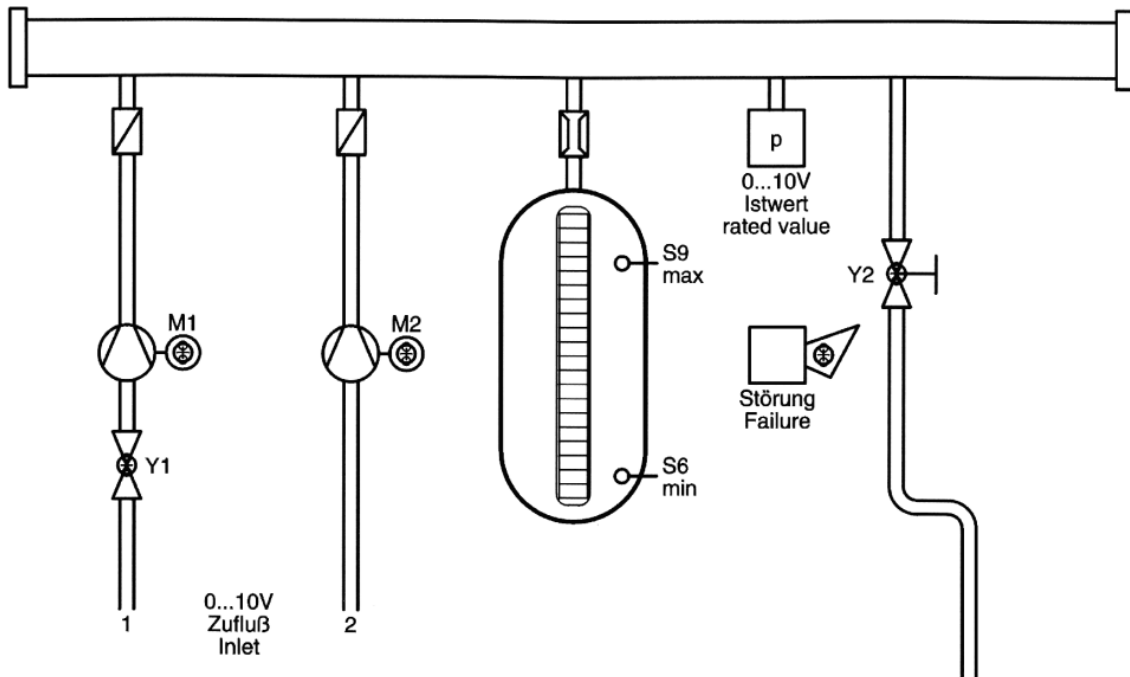


Figure 2: Process Schematic

Functions to be programmed:

The following functions should be programmed in the SPS:

The indicators S9 and S6 show the maximum and minimum state of the system pressure (delivered by the sensors S6 and S9).

Using the buttons "Automatic" and "Manuell" the operation mode is set. The mode is displayed by the indicators "Automatic" or "Manuell". A selection or change of the operating mode can be performed only if the switch "Start/Stop" is in the position "Stop"

In the **mode "Manuell"**, the switch "Start/Stop" is without function and with the button "Failure" the function of the horn (LED "Failure") can be tested. Using the buttons "Max" and "Min", the system pressure can be manually controlled over the pump M1 and M2 and the valve Y1 ("Max": increase pressure) and the valve Y2 ("Min": decrease pressure).

In manual mode ("Max" = on) the pump M1 works with 50 % and the pump M2 with 20%.

The running system in **automatic mode** is displayed by the activated indicator "Start/Stop".

The outlet Y2 is opened the entire time, the outlet rate can be adjusted manually via the dial "Outlet".

In automatic mode, by turning the switch "Start/Stop" on, the system pressure should be maintained within a range between a maximum of 80 % and a lower limit of 50 %, even if air is constantly removed and thereby the flow value varies.

For the base load the inlet supply M2 works with 20 % and the supply M1 should switch on / off with 50 %.

If the pressure rises to the maximum value (Sensor S9) because the outlet flow is too small, i. e. the dial "Outlet" is set to position 1, the failure horn (LED "Failure") is switched on until the value drops below 50 % again (i. e. if you close the inlets Y1, M1 and M2).

If the pressure drops below the minimum value (S6) because the outlet flow is too large, i. e. the dial "Outlet" is set to 9, both pumps are switched to a flow capacity of 70 % until the value of the system pressure is increased again to 80%.

Hints:

You can create the project, program the OB1 and download/monitor the program according to the project SCD [2] but you have to use the language "function block diagram" (FBD). Create the Function Block FB1 as FBD!

You can drag-and-drop the necessary function from the function list of the SIMATIC Manager (figure 3).

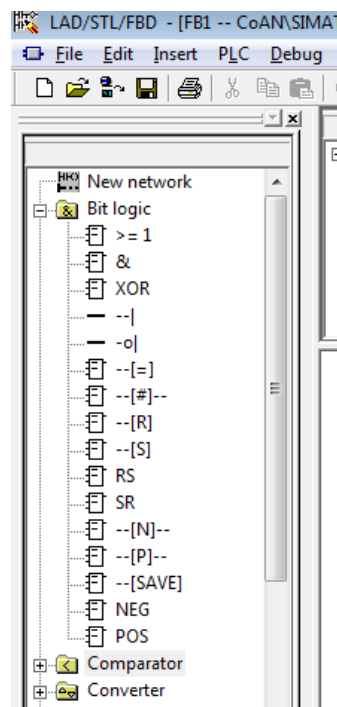


Figure 3: Function List

2 Symbol Table

symbol	adress	datatype	comment
Y1	A 136.0	BOOL	valve in the inlet/inflow Y1
Y2	A 136.1	BOOL	valve in the outlet/outflow Y2
M1	A 136.2	BOOL	motor M1
M2	A 136.3	BOOL	motor M2
Led_Failure	A 136.4	BOOL	indicator for failure (horn)
Led_Start/Stop	A 136.5	BOOL	indicator for start
Led_Manuell	A 136.6	BOOL	indicator for manual operation
Led_Automatic	A 136.7	BOOL	indicator for automatic operation
Led_S9	A 137.0	BOOL	indicator maximum pressure exceeded
Led_S6	A 137.1	BOOL	indicator minimum pressure exceeded
Failure	E 136.0	BOOL	button Failure NO
Start_Stop	E 136.1	BOOL	switch Start/Stop
Manuell	E 136.2	BOOL	button manual mode NO
Automatic	E 136.3	BOOL	button automatic mode NO
Max	E 136.4	BOOL	button maximum pressure NO
Min	E 136.5	BOOL	button minimum pressure NO
S6	E 136.6	BOOL	sensor for minimum pressure NO
S9	E 137.1	BOOL	sensor for maximum pressure NO
Inlet_M1	PAW 800	INT	pump power motor 1
Inlet_M2	PAW 802	INT	pump power motor 2
Actual_Value	PEW 800	INT	air pressure in the net

3 Tasks

1) Connecting the Hardware

Connect the Digital Input/Output of the module with the PLC via the cable!

Connect the Grounds ("M") of the module, the analog inputs of the module ("Inlet M", "Inlet M2") and the analog output of the module ("Actual value") with the according terminals of the PLC ("M", "PAW 800", "PAW802" and PEW800")!

2) Creating the symbol table

Create the basic symbol table according to 2!

3) Digital In/Output and use of FlipFlops

Program the logic for the switching of the operation mode and display the mode on the indicators!

You can use flipflops to store the operation mode, figure 4 shows an example.

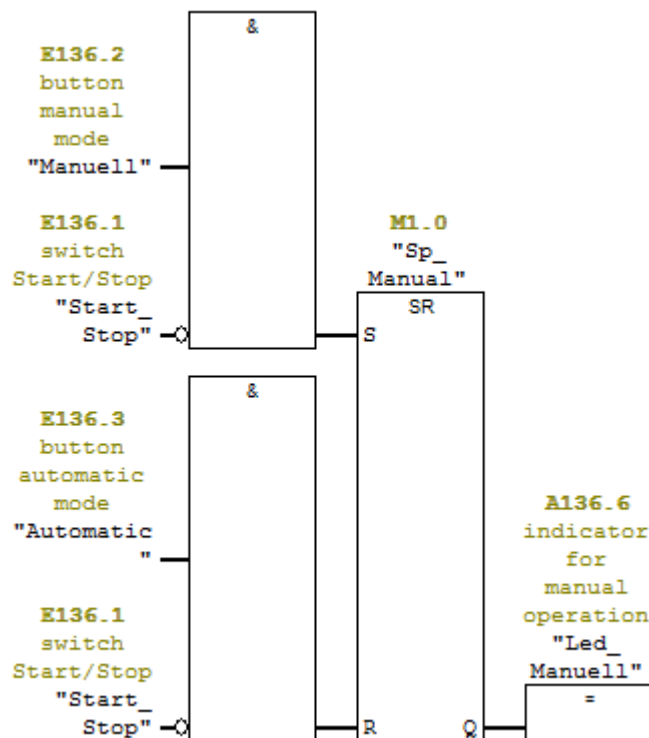


Figure 4: Digital in/Output and use of a flipflop

Add the part for the operation mode "Automatic"!

4) Reading, Scaling and Comparing Analog Inputs

Program the analog input of the actual value of the air pressure (PEW800), scale it into a range of 0 – 100%, compare it with the minimum value of 50% and the maximum value of 80% and display the decreasing/increasing of the value below/over the minimum/maximum with the indicator "LED_S6" (minimum) and "LED_S9" (maximum)!

You can use the function "SCALE" (FC105 in Libraries/Standard Library/TI-S7 Converting Blocks) to read in and scale analog values (figure 6), the OUT-value (MD30) has to be defined as "REAL".

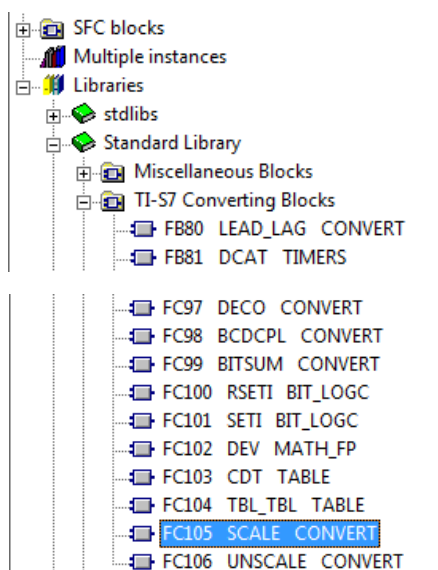


Figure 5: FC105

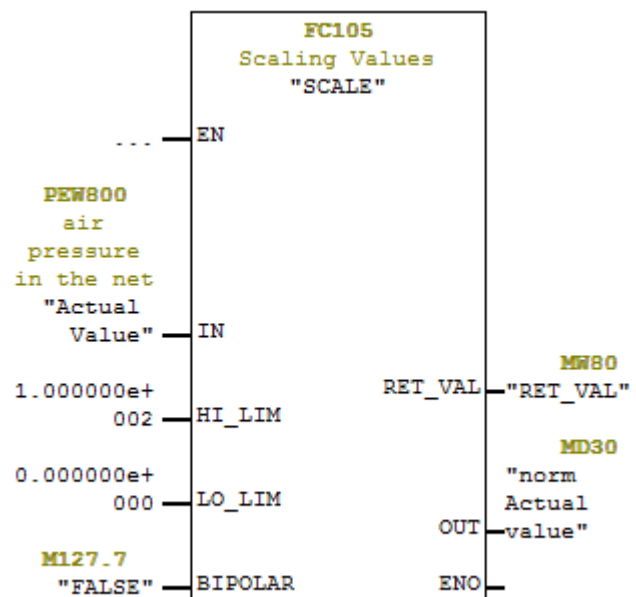


Figure 6: Reading and Scaling Analog Inputs

The state false for the Input of "BIPOLAR" can be generated with the logic according to figure 7.



Figure 7: Generating of "false"

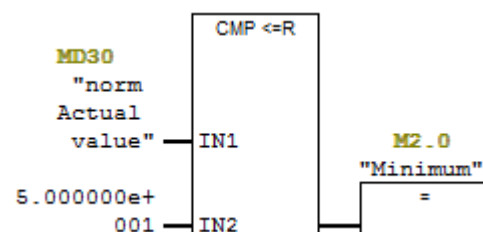


Figure 8: Comparing Analog Values

You can compare analog values with a given limit according to figure 8. The symbol "Minimum" will be used later, connect it to "LED_S6" for indication of the reached minimum!

Add the part for the indicating of the reached maximum ("CMP >=R")!

To check the function of your program you can use the button "Max" to switch on the valve "Y1" (increase pressure) and the button "Min" to switch on the valve "Y2" (decreasing pressure). **Add this testfunctions!**

The volume of the inflow of the air through Y1 can be set with the dial "Inlet M1" when the switch "Manuell Automatic" (located over the switch "Mode1") is set to "Manuell", the volume of the outflow of the air through Y2 is set with the dial "Outlet"!

5) Unscaling and Writing Analog Outputs

Create a variable for the analog output to the pump M1, set the value of the output depending on the states of the buttons "Min" and "Max", unscale and output the value to the analog output PAW800 of the PLC ("Inlet_M1") and activate the pump "M1" and the valve "Y1" if "Inlet_M1" > 0%.

"Min" = true: "Inlet_M1" = 20%

"Max" = true: "Inlet_M1" = 70%

else "Inlet_M1" = 0%

You can move a value to a variable depending on the logic states of digital inputs with the function "MOVE" (figure 9).

The OUT-variable (MD10) has to be defined as "REAL".

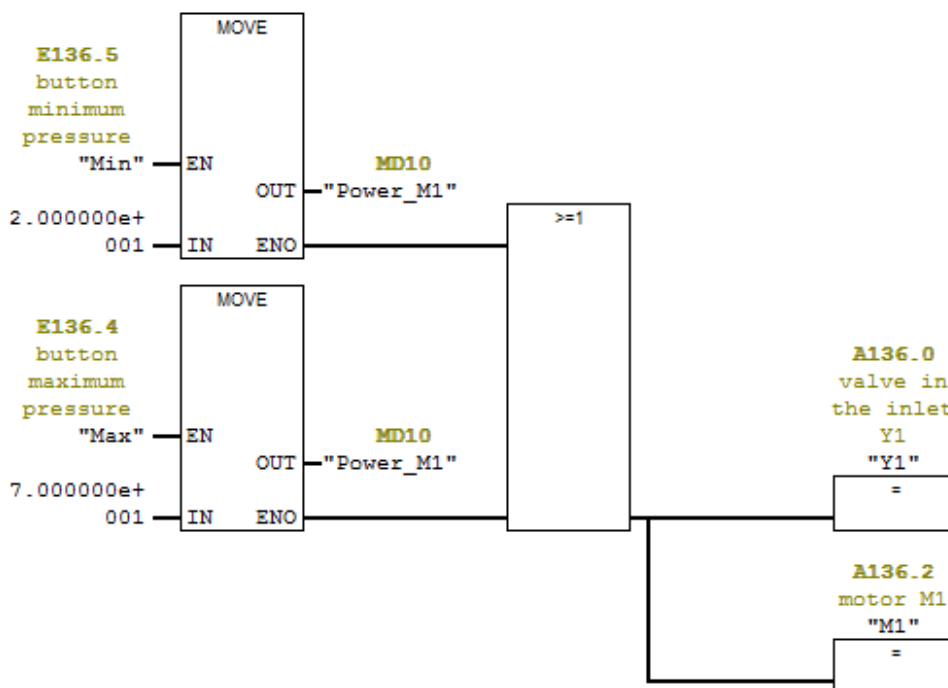


Figure 9: Moving Values

Add the logic for "Inlet_M1" = 0%!

You can use the function "UNSCALE" (FC106) to convert values from 0-100% to an output of 0-10V (figure 10) and output this analog value!

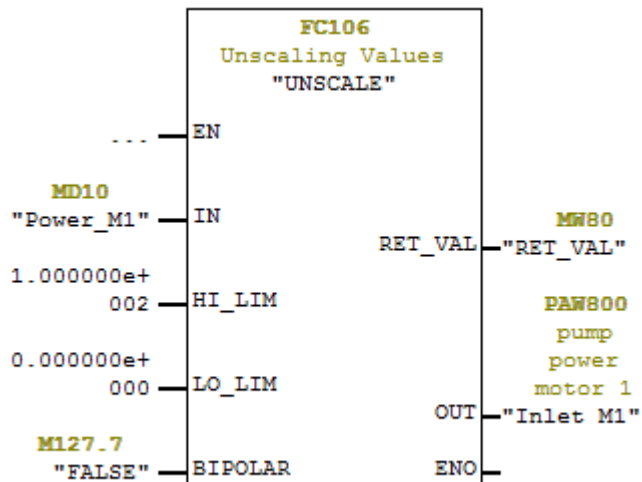


Figure 10: Unscaling and Writing Analog Outputs

PAW800 will control the pump power of M1 when the switch "Manuell Automatic" (located over the switch "Mode1") is set to "Automatic"!

To check the function of your program you can use the button "Failure" to switch on the valve "Y2" (decreasing pressure). **Add this function!**

6. Completing of the functions

Complete or rearrange the functions of the programm according to the description in 1!

4 References

- [1] Manual S7-GRAPH V5.3 for S7-300/400 Programming Sequential Control Systems
- [2] Experiment Instructions SCD Sequence Control of a Drilling Machine by SIMATIC S7-300